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The impact of the COVID-19 pandemic on TB diagnosis in the Brazilian prison population, 2020–2021

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SUMMARY

BACKGROUND: TB is an infectious disease with a worldwide impact. TB is closely associated with social and housing conditions, exerting a significant impact on the prison population, which is particularly susceptible to the disease. Evidence suggests that the COVID-19 pandemic has exacerbated social vulnerability. This study therefore aimed to analyse the impact of the pandemic on the diagnosis of new cases of TB in the Brazilian prison population in the years 2020 and 2021.

METHODS: This is an ecological study involving cases of TB recorded in the prison population of Brazil from 2015 to 2021. Data were collected from the Brazil's Information System for Notifiable Diseases.

RESULTS: The incidence of TB in the prison population in Brazil fell from 1,005.9/100,000 population between 2015 and 2019 to 852.3/100,000 population between 2020 and 2021. In 2021, there was a deficit of 539 cases (–7.6%) compared to what was expected for the year. In 2020, there was a 10% reduction in TB diagnoses in January and February, reaching 3.8% in March. A negative percentage was observed in most of the subsequent months. In 2021, the year began with a 21.6% decline in January, returning to positive values only in August and September.

CONCLUSION: The first years of the COVID-19 pandemic resulted in underdiagnosis of TB in the Brazilian prison population.

KEY WORDS: epidemiology; coronavirus disease; health services; prison inmates; *Mycobacterium tuberculosis*

TB is a centuries-old infectious disease caused by *Mycobacterium tuberculosis* complex.[1] Its transmission occurs by direct contact with infected individuals, and despite the availability of treatment, it is still considered a public health problem, especially in developing countries. It is estimated that a third of the world's population is infected with *M. tuberculosis*, 10% of whom develop the active form of the disease during their lifetime.[2,3]

Even with advances, estimates were that at least 10 million cases of the disease would be diagnosed by 2020.[1] In that year, however, 5.8 million cases were diagnosed, reflecting one of the many impacts of the COVID-19 pandemic on the fight against TB. While a reduction in the number of diagnosed cases was observed, an increase in mortality was observed. In 2020, there were about 1.3 million deaths from the disease in HIV-negative individuals, and 214,000 deaths in HIV-positive individuals. While in 2019, the pre-pandemic year, respectively 100,000 and 5,000 fewer deaths were recorded in HIV-negative and HIV-positive individuals.[2]

The prison population is one of the most vulnerable groups for TB transmission and infection. The prison population is defined as individuals over 18 years of age under state custody in prison units;[4] it is estimated that their risk of becoming ill is 35 times higher than that of the general population.[5] Furthermore, evidence shows that the prison population plays an important role in the chain of TB transmission in the general population, and not only within prisons.[6]

Brazil stands out as one of the 20 countries with a high burden for TB and TB-HIV coinfection,[7] also having one of the largest prison populations in the world, second only to the United States and China.[8] It is estimated that there are approximately 750,000 individuals in this situation, according to 2019 data (individuals under closed, semi-open and open regimes, provisional inmates, in compliance with security measures and those in outpatient regime).[9] In addition, between 2011 and 2017, Brazil accounted for a 45% increase in the number of TB cases in the prison population in South America.[10,11]

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The dramatic relationship between TB and the prison population is aggravated by the context of pragmatic vulnerability to which this population is exposed, especially due to the overcrowding in prison units and the reduced access to health services. Of the 1,381 prison units in Brazil, 997 (72.19%) have 100% occupancy, in the remaining 276 (19.9%) occupancy exceeds 200%. In terms of physical structure, for example, among these 1,381 prison units, there are about a thousand medical offices and a little more than 700 dental offices.[9]

Faced with the threat to public health posed by the disease, in 2012, the WHO proposed the End TB Strategy, aiming to end the global epidemic. The proposed targets aim to reduce the number of deaths from TB by 95% by 2035.[3] Between 2015 and 2020, the cumulative reduction in global prevalence of the disease was 11% – just over half of the 20% reduction proposed by the WHO. Even with a downward trend between 2011 and 2016, there was an increase in incidence between 2017 and 2020, concentrated mainly in vulnerable populations, such as the prison population.[2,7]

The COVID-19 pandemic has presented a significant challenge for government authorities, necessitating the implementation of social isolation measures and proactive strategies to combat the novel virus.[12] Despite its nationwide spread, the arrival of SARS-CoV-2 in Brazil has exhibited variations across different populations, influenced by socio-economic, health, and demographic factors. Consequently, regions characterized by high population density and limited capacity of the healthcare system have experienced higher prevalence and mortality rates.[13]

Given the above, this paper aimed to analyse the impact of the COVID-19 pandemic on the diagnosis of new TB cases in Brazil's prison population in the years 2020 and 2021.

METHOD

This is an ecological study involving cases of TB recorded in the prison population in Brazil from 2015 to 2021. Only 'new cases', 'do not know' and 'post-obit' were included. These three conditions are recommended by the Brazilian Ministry of Health for the purpose of calculating the incidence rate. Those cases closed as misdiagnosis were excluded.

It should be noted that in 2014, the variable 'special populations' was included in the Brazilian database of the unified health system. In 2015, the variable 'institutionalised' was discontinued. Since then, for epidemiological purposes, it is recommended that only the variable prison population = yes be used. Although the prison population is composed of individuals aged ≥18 years, in this study those aged 18 and 19 years were not included, as the data on TB made available by the Brazilian Department of Informatics of the Unified Health System (*Departamento de Informática do Sistema Único de Saúde*, DataSUS) are aggregated into predefined age groups. Individuals aged 18 and 19 years are included in the '15–19 years' range. The choice not to include these individuals was justified because this age group is composed of three ages (15, 16 and 17) that are not considered as prison population.

The Notifiable Diseases Information System (*Sistema de Informação de Agravos de Notificação*, SINAN), the National Penitentiary Department Information System (*Secretaria Nacional de Políticas Penais*, SISDEPEN), and the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatistica*, IBGE) were used as the database for data collection.

To calculate the incidence rate, the following equation was used:

$$\text{TB incidence rate} = \frac{\textit{number of new cases reported in the year}}{\textit{total prison population in the year}} \times 100.000$$

To quantify the impact of the COVID-19 pandemic on the number of TB cases, the percentage change was used, using the following equations:

a) Impact in 2020:

$$\textit{Percentage change} = \frac{\textit{no. of confirmed cases}\ (2020) - \textit{no. of expected cases}\ (\textit{mean}\ 2015-2019)}{\textit{no. of expected cases}\ (\textit{mean}\ 2015-2019)} \times 100$$

b) Impact in 2021:

$$\textit{Percentage change} = \frac{\textit{no. of confirmed cases}\ (2021) - \textit{no. of expected cases}\ (\textit{mean}\ 2015-2019)}{\textit{no. of expected cases}\ (\textit{mean}\ 2015-2019)} \times 100$$

Where, 1) the event analysed is the number of confirmed cases of TB; 2) the expected value for the year is calculated based on the last 5 years prior to the beginning of the pandemic, as recommended.[14]

The results were presented in absolute numbers and proportions. As only secondary data from public domain information systems, in which it is not possible to identify individuals, were used in the study, authorisation from the Research Ethics Committee was not required.

RESULTS

Between 2015 and 2021, 49,520 cases of TB were reported in the prison population in Brazil. In the

pre-pandemic period, the annual average of cases was 7,122 (incidence = 1,005.9/100,000). In the pandemic period, this mean decreased to 6,955 (incidence = 852.3/100,000) (Figure 1). See https://figshare.com/articles/figure/Figures-_The_impact_of_Covid-19_on_the_TB_pdf/22651015 for Figures 1–4.

In 2020, when compared to the average number of cases in 2015–2019, a discrete increase of 2.9% was observed in the number of new cases of TB in the prison population. The Southeast (–8.1%) and Central-West (–10.3) Regions were the only ones that showed a reduction, while the North (50.7%) and Northeast (15.3%) Regions showed a percentage increase. Thirteen Brazilian states showed a reduction in the number of TB cases, especially Santa Catarina (–38.8%), Paraíba (–35.1%), Alagoas (–34.1%) and São Paulo (–30.4%), which had a >30% decline (Figure 2A).

In the light of expected estimates for 2021, we observed a reduction in the number of cases nationally (–7.6%), representing an underdiagnosis of 539 TB cases. The Southeast (–15.3%), South (–17.3%) and Central-West (–9.0%) Regions showed a percentage drop. As in 2020, 13 states presented a decline, with Mato Grosso (–54.0%) and the Federal District (–48.2%) experiencing unprecedented reductions (Figure 2B).

In 2020, in terms of the month of notification, we observed a growth of more than 10% in the number of diagnoses in the country (37.1% in January and 14.6% in February), with the North region standing out (115.7% in January and 94.4% in February). In March – the month the pandemic of COVID-19 was declared –growth was 3.8%, but became negative in April, May, June, August, October, November and December. The months of May and November presented the largest declines (–9.0% and –7.2%, respectively). Decline in the Southeast Region began in March, reaching –24.5% in August and –22.7% in November (Figure 3).

The impact of the pandemic was more evident in 2021. Except for the North Region, all other regions began the year with a decline in the number of confirmed TB cases. Nationally, a decline of 21.6% in relation to the expected number of cases was noted. The national variation remained negative in 10 of the 12 months of 2021 (except for the months of August and September). The Southeast Region experienced the greatest reduction in January (–34.8%). Only in September did all the regions show a positive variation, especially the North (30.8%). On the other hand, in December, all the regions presented a negative variation, with the Central-West (–96.0%) and the North (–50.0%) having unprecedented declines (Figure 4).

DISCUSSION

This study analysed the impact of the COVID-19 pandemic on the notification of TB cases in the Brazilian prison population. Although the pandemic had an immediate impact, this was notably more substantial in the year 2021, when at least 539 cases were no longer diagnosed, corresponding to a decline of 7.6% of what would be expected. Unequal impacts were observed among regions, with a more intense decline in 2021 in the South and Southeast Regions. These regions showed a trend of increasing cases in 2018 and 2019.[15]

The prison population is marked by limited availability of financial and organisational resources, resulting in reduced access to disease prevention measures and healthcare services. This vulnerability contributes to a higher risk of illnesses and diseases. The National Council on Criminal and Penitentiary Policy (CNPCP), in Resolution No. 4 of 18 July 2014, established the Basic Guidelines for Comprehensive Health Care for Persons Deprived of Liberty, with the main objective of implementing basic health units intramurals, fostering the coordination of care and access to other care networks of the Unified Health System (*Sistema Único de Saúde*, SUS).[16] However, this implementation still does not meet the demands of the prison population. In 2022, the South and Southeast Regions, which represent 50% of prison health services in the country, had medical offices in less than half of prison units.[17]

The National Council of Justice sought, through resolution 62/2020,[18] to decrease crowding in prison units and thus mitigate the effects of the spread of COVID-19 within the prison system. There was then an increase in the proportion of prisoners under the open regime, from 3.4% of the total in December 2019 to 6.5% in June 2020, with about 23,000 more prisoners in 2020 under this regime. Although the proportion of convicted convicts under the closed regime and pre-trial prisoners fell proportionally, there were 13,437 more people serving sentences under more restrictive regimes, when evaluated in absolute values.[19]

Between 2020 and 2021, there was an increase of 123,064 vacancies in the Brazilian prison system, totalling 634,469 vacancies at the end of 2021.[20] Despite this, there was still a deficit of 180,000 vacancies in that year, giving a ratio of 1.3 inmate for each available vacancy, maintaining a scenario of crowding and inadequate health conditions.[19,21]

It was expected that the conjunction of historical, social, economic and structural factors would generate a scenario with even more negative outcomes during the pandemic in the prison population. In the early months of 2020, it was estimated that a prisoner infected with SARS-CoV-2 would in turn infect approximately 10 people; this was higher than the estimate for the general population, where each infected individual was likely to infect three people.[22] In October of that year, the Brazilian Public Security Yearbook released the first analyses on the pandemic, showing a 62% higher incidence rate in the prison environment compared to the country.[23] This was a result of overburdened services, reduction in the number of health

professionals due to leaves of absence, suspension of care for people with chronic diseases and increased risk of SARS-CoV-2 infection in the prison setting.[24]

Another important measure that may have contributed to this scenario was the Ministry of Health's guidance on TB control during the COVID-19 pandemic. Aiming to reduce the infection by COVID-19, the Circular Letter released in March 2020 recommended a reduction in investigations for latent TB in asymptomatic individuals in direct contact with individuals with active TB, affecting the possible diagnoses of the portion of the prison population that was directly exposed to the infection.[25]

Evaluating the results of this study, it may be inferred that the reduction in the percentage of new cases of TB reflects underreporting. The Southeast Region, for example, already showed a downward trend in March 2020, deviating from its previous pattern. Between 2015 and 2019, there was a 132% increase for the same month in the number new TB cases compared to the previous month.[26,27]

Misdiagnoses due to similar respiratory symptoms caused by SARS-CoV-2 may have contributed to a reduction in the suspicion and investigation of TB and, consequently, underreporting of the disease in the country. A North American study evaluating the impact of COVID-19 on TB diagnosis in an infectious disease clinic showed that 43% of TB patients were tested for SARS-CoV-2, showing a positivity rate of 7.5%.[28]

These results, together with the pattern of TB diagnoses in the general population in this period, reflect a worldwide diagnostic impairment caused by the COVID-19 pandemic. A Chinese study looked at the impact of the pandemic on TB diagnoses, using as a parameter the time interval of the Spring Festival, a major Chinese holiday when families gather together and tend not to seek health services. Between 2017 and 2019, this period generated a 76% drop in TB notifications, but there was an immediate growth curve and the pattern returned to its baseline a week after the holiday. In 2020, it took about 10 weeks for the numbers to stabilise.[29] In relation to the general population, Brazil showed a reduction of 8.3% in TB notifications and 17.1% in positive smears over what was expected for the year 2020, compared to the period 2015–2019.[27]

In June 2020, when the percentage of the number of TB cases in Brazil's prison population showed a small rise, most states in the country were creating return-to-activities protocols.[30–33] This positive outlook meant that in July, when the country's main non-core activities were reopened, the percentage of positive change was positive for the first time since the pandemic began. The Central-West Region, except for Brasilia, had no concrete plans to reopen activities that month, justifying its lagging pattern of diagnostic growth compared to the country.[34,35] Although in the South Region reopened before the other states, the positive trend continued to be noted in May 2020.[36,37]

In August of that year, a further drop in TB diagnoses occurred nationally just after Brazil had the highest average number of COVID-19 deaths in 2020 in the last 2 weeks of July, and the highest number of deaths in 24 hours was recorded that year on July 29. According to data from Brazil's Ministry of Health, there were 1,595 COVID-19 deaths in the country that day.[38,39]

Between November and December 2021, while the moving average of COVID-19 cases and deaths remained stable and vaccination efforts progressed, there was growing apprehension regarding a potential strain on healthcare services, when the first cases of the omicron variant were reported in the country. Due to its greater ability to spread and the uncertainty regarding the efficacy of the vaccines against the variant, as well as the rise in suspected cases of COVID-19 due to the circulation of the Darwin variant of the H3N2 virus and its symptomatic similarity with SARS-CoV-2 infection,[40] there was a decline in TB diagnoses in the Brazilian prison population.

The increase in the percentage of variation in the Central-West Region in September (16.7%) and October (110.8%) of 2021 is noteworthy, much higher than that observed in the other regions of the country. However, this significant variation in the region was influenced by the increased diagnosis in the state of Mato Grosso do Sul (82.4% in September and 266.2% in October). In this state, 17 cases were expected in September (31 were registered) and 14 in October (52 were registered). It is likely that this increase is explained by the accumulation of undiagnosed cases in the previous months.

It is also worth highlighting the relevance of the management of prison health teams in the pandemic in the reflection of TB diagnoses among the prison population in Brazil. In the North Region, where notification varied positively in pandemic years from what was expected, the proportion of doctors and nurses in the prison system increased from 31.4 to 57 per 10,000 prisoners between 2019 and 2021, which represented a growth of 81.2%, being the largest increase in the number of professionals among the country's regions during that period.[41]

On the other hand, the South Region, which in 2021 showed the largest reduction in the percentage diagnosed with TB in the prison population (–17.3%), was also the region with the smallest growth in the number of doctors and nurses during the pandemic. The approximately 27.5 professionals per 10,000 inmates in 2019 rose to 31.8 professionals per 10,000 inmates in 2021, representing a growth of 15.4%. It is worth noting that even with the spread of the pandemic, there was a 3.9% drop in the number of professionals between 2020 and 2021 in this region (from 33.1 to 31.8/10,000 inmates).[41]

Furthermore, it should be noted that the significant variations observed in the study could also have resulted from the combination of two factors: low number of expected cases (average of 2015–2019) and the increase in the prison population, which in practice, raises the number of diagnoses. In Roraima, for example, only 25 cases of TB were expected in the prison population in 2021, but 73 individuals were diagnosed. This increase in diagnosis may be related to factors related to health services, as well as to the increase of incarcerated individuals and the overcrowding of the state's prison units, which increases the risk of contamination.

Despite the established relationship between access to healthcare teams and the reduction in the prevalence of TB in the population,[42] there is probably a relationship between the availability of access to health services and the number of diagnoses of TB.[43] In the case of the prison population, the presence of healthcare professionals within correctional facilities may contribute to an increase in TB diagnoses. This is due to the detection of infections that may have occurred prior to incarceration but were not symptomatic at the time; this does not reflect the ongoing transmission of TB within the prison environment. Furthermore, the history of underdiagnosis in this context, stemming from the inadequate infrastructure and a shortage of skilled professionals for accurate diagnosis, is mitigated by the expansion of healthcare teams.[44]

This study presented some limitations. Of these, the most noteworthy was the utilisation of secondary data, as their reliability was affected by the capacity of the local surveillance system. Furthermore, the COVID-19 pandemic had had a significant impact on the process of case notification, typing and investigation, further compromising the quality of the data. Another limitation lies in the inability to collect data specifically for individuals aged 18 and 19 years, as these were grouped within the 15–19 age category. Consequently, this led to incomplete data concerning the prison population.

CONCLUSIONS

The first 2 years of the COVID-19 pandemic had a direct impact on TB diagnosis in the Brazilian prison population, leading to a lower number of cases than initially anticipated. This fact may be related to the way health management was conducted during the pandemic period, requiring studies that can evaluate this relationship in Brazilian states and regions, as well as an evaluation of TB diagnoses in the prison population in other countries during the same period.

Conflicts of interest: none declared.

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RÉSUMÉ

CONTEXTE : La TB est une maladie infectieuse ayant un impact mondial. La TB est étroitement liée aux conditions sociales et de logement, ce qui a un effet significatif sur la population carcérale, particulièrement vulnérable à cette maladie. Des preuves suggèrent que la pandémie de COVID-19 a exacerbé la vulnérabilité sociale. Cette étude avait donc pour objectif d'analyser l'impact de la pandémie sur le diagnostic de nouveaux cas de TB au sein de la population carcérale brésilienne en 2020 et 2021.

MÉTHODES : Il s'agit d'une étude écologique portant sur les cas de TB enregistrés dans la population carcérale du Brésil de 2015 à 2021. Les données ont été recueillies à partir du Système d'Information des Maladies à Déclaration Obligatoire du Brésil.

RÉSULTATS : L'incidence de la TB dans la population carcérale du Brésil est passée de 1 005,9 pour 100 000 habitants entre 2015 et 2019 à 852,3 pour 100 000 habitants entre 2020 et 2021. En 2021, il y a eu un déficit de 539 cas (–7,6%) par rapport à ce qui était attendu pour l'année. En 2020, il y a eu une réduction de 10% des diagnostics de TB en janvier et février, atteignant 3,8% en mars. Un pourcentage négatif a été observé pour la plupart des mois suivants. En 2021, l'année a commencé par une baisse de 21,6% en janvier, les valeurs positives n'ont été retrouvées qu'en août et septembre.

CONCLUSION : Les premières années de la pandémie de COVID-19 ont entraîné un sous-diagnostic de la TB au sein de la population carcérale brésilienne.